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[54] ORTHOCARTOGRAPH

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[52] **U.S. Cl.**..**355/22**
[51] **Int. Cl.**..**G01c 11/18**
[58] **Field of Search**....................33/1; 353/6; 355/22

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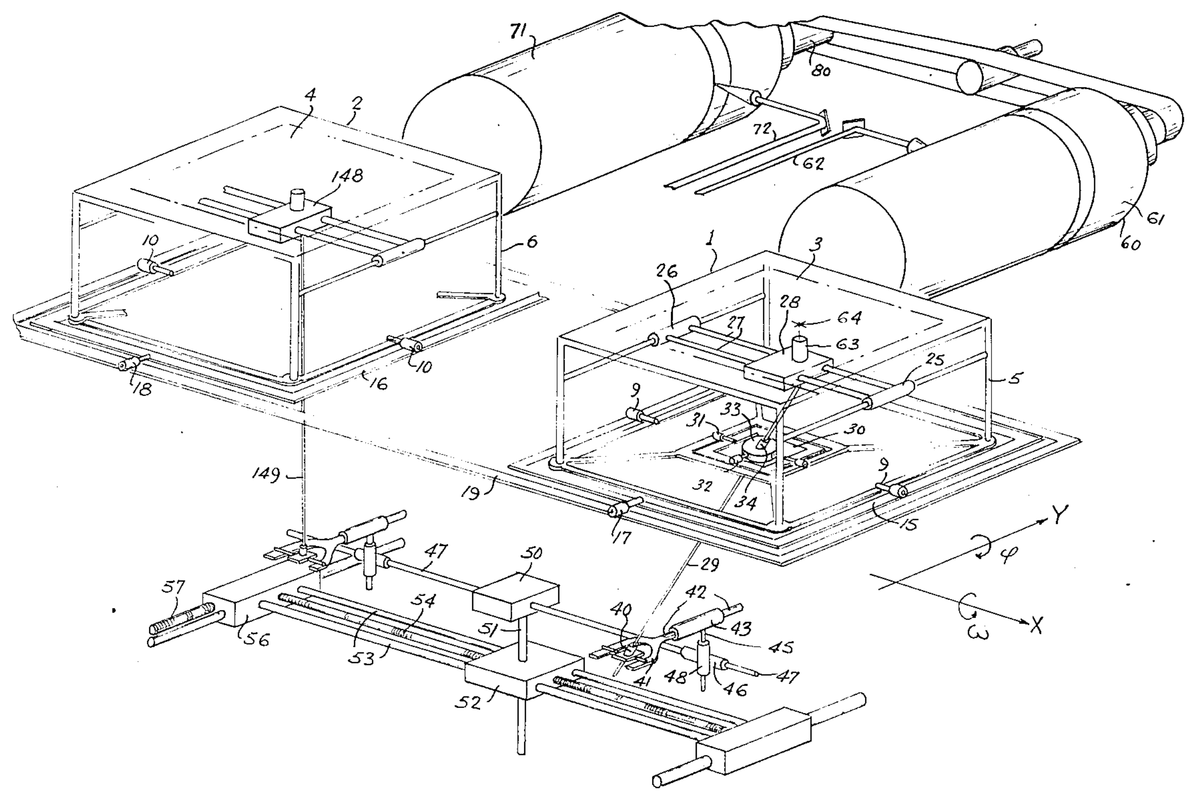
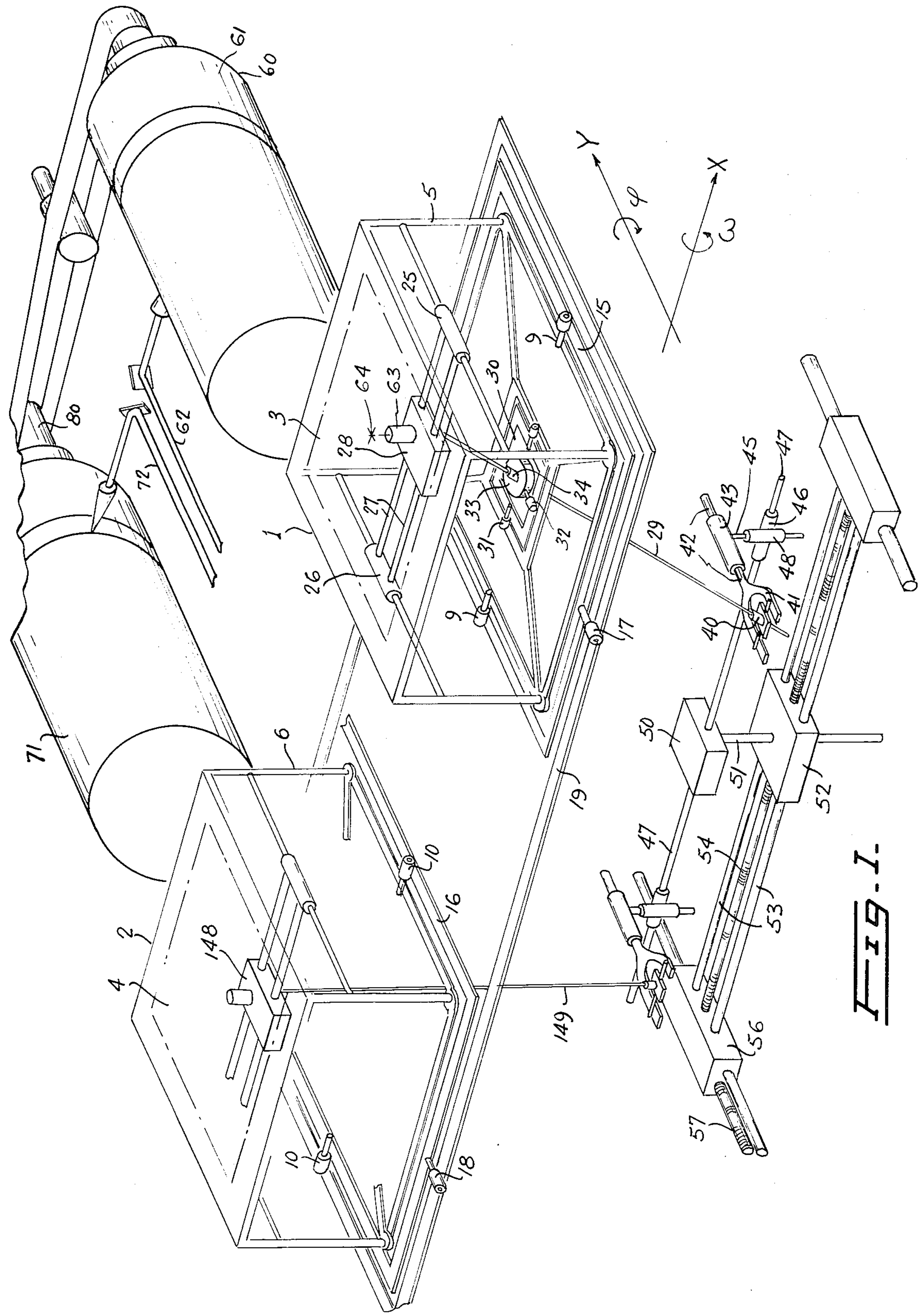
[57] **ABSTRACT**

An orthocartograph is disclosed which is in the form of a mechanical photogrammetric plotter from which corresponding sections of stereophotographic images are corrected and transferred simultaneously by an optical train and printed simultaneously on light sensitive films in a printing unit. The relative positions of both films in every point is rigidly controlled so that orthophotos are produced. Magnification of the image from the stereo-photographic images is varied in accordance with a Z-coordinate at right angles to X- and Y-coordinates and in accordance with an ω -tilt about the X-axis and a ϕ-tilt about the Y-axis, relative to the principal point. Scanning being performed in the X-direction, the image is rotated in accordance with the ω -tilt about the X-axis.

10 Claims, 5 Drawing Figures

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61
62
63
64
71
72
80
148
149
X
Y

Fig. I.

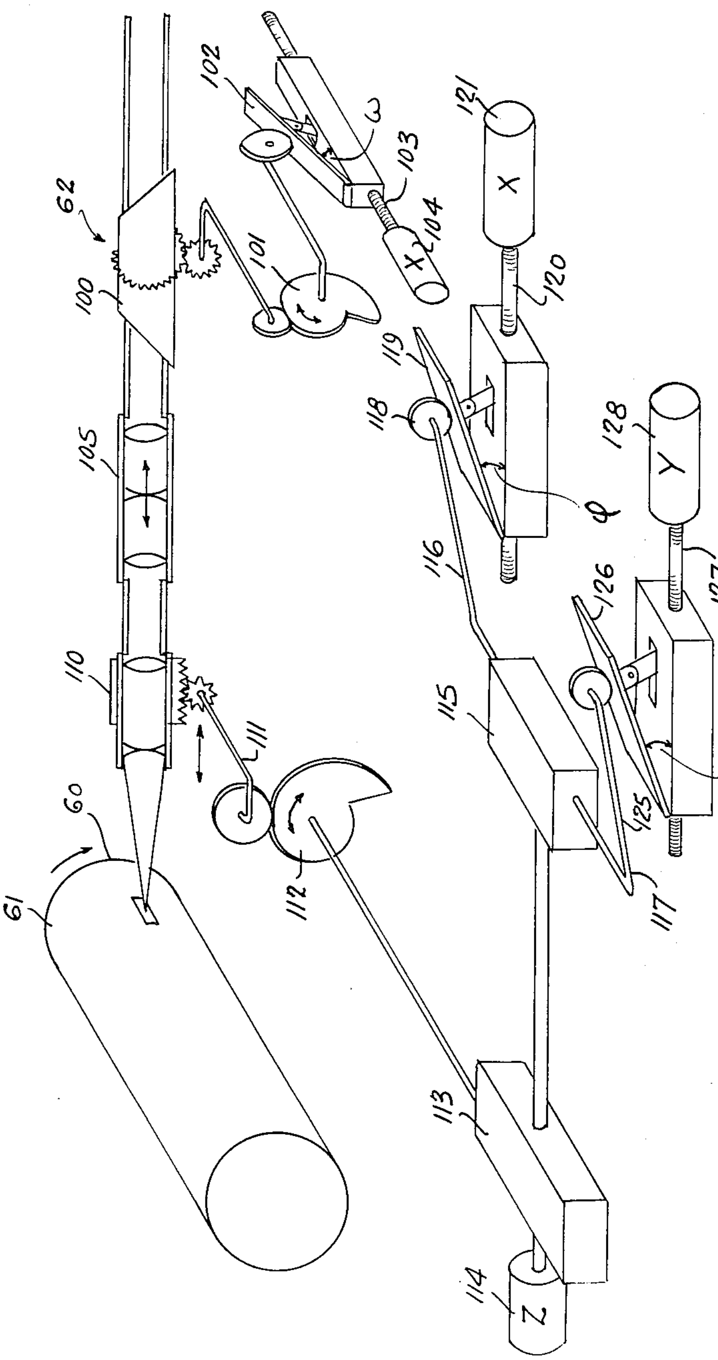

62
102
100
101
ω
103
104
X
121
X
120
105
119
118
φ
128
Y
127
116
126
110
115
111
ω
60
125
61
112
117
113
114
Z

FIG. 2.

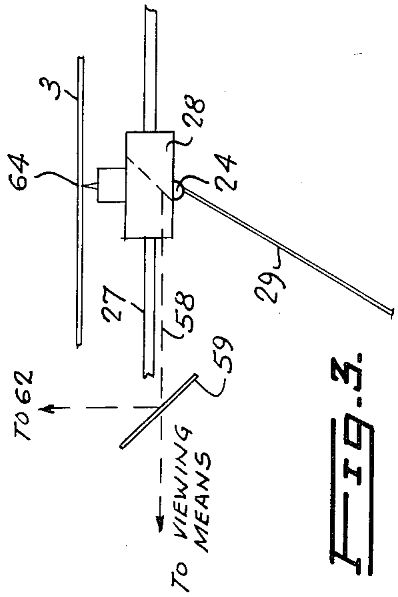
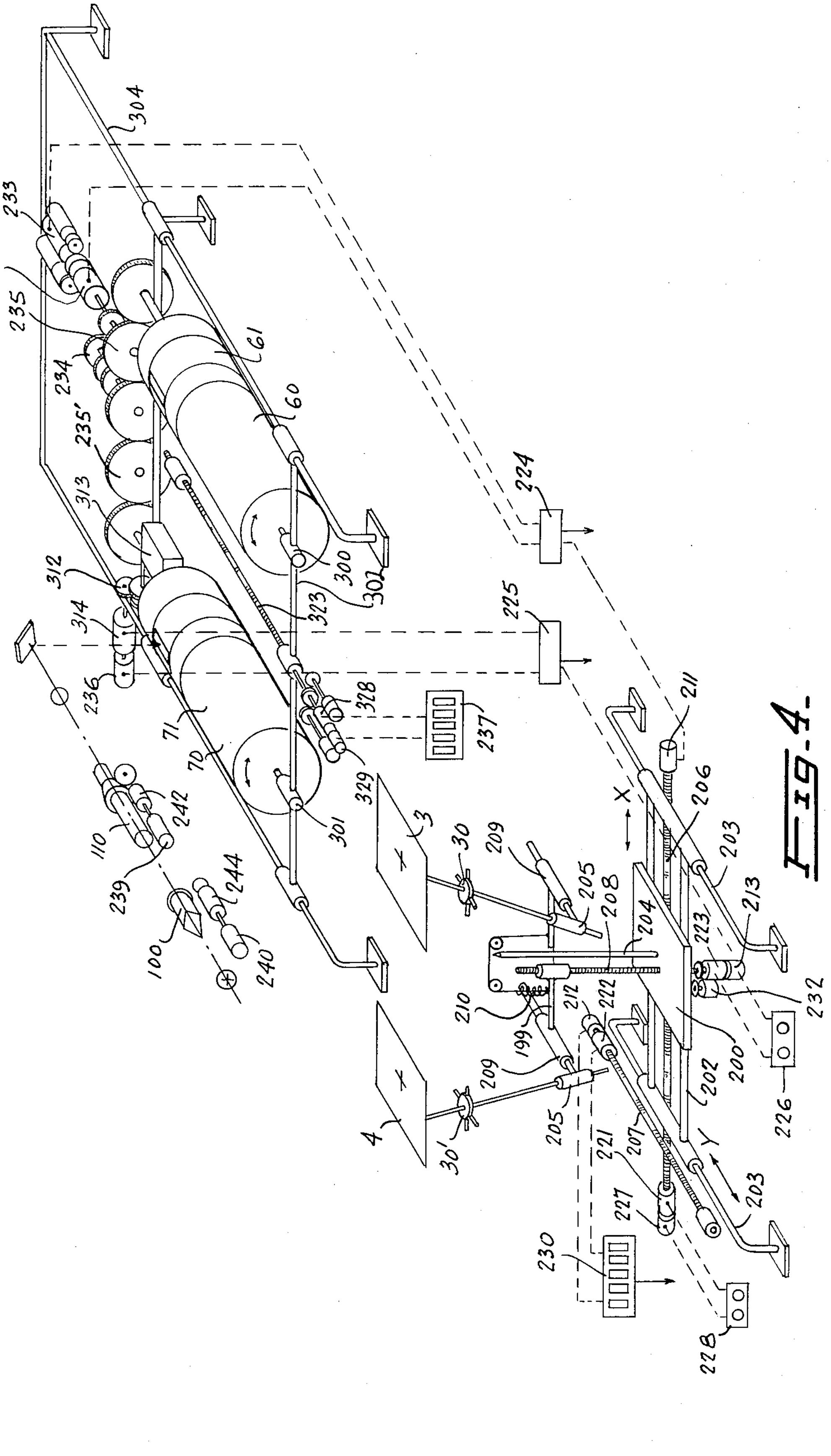

3
28
64
24
27
58
29
59
TO 62
TO VIEWING MEANS

FIG. 3.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233
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302
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71
70
301
242
110
239
244
100
240
3
30
209
205
208
204
206
X
203
213
223
232
200
226
202
222
212
210
199
209
4
30'
205
221
207
Y
203
227
230
228

Fig. 4.

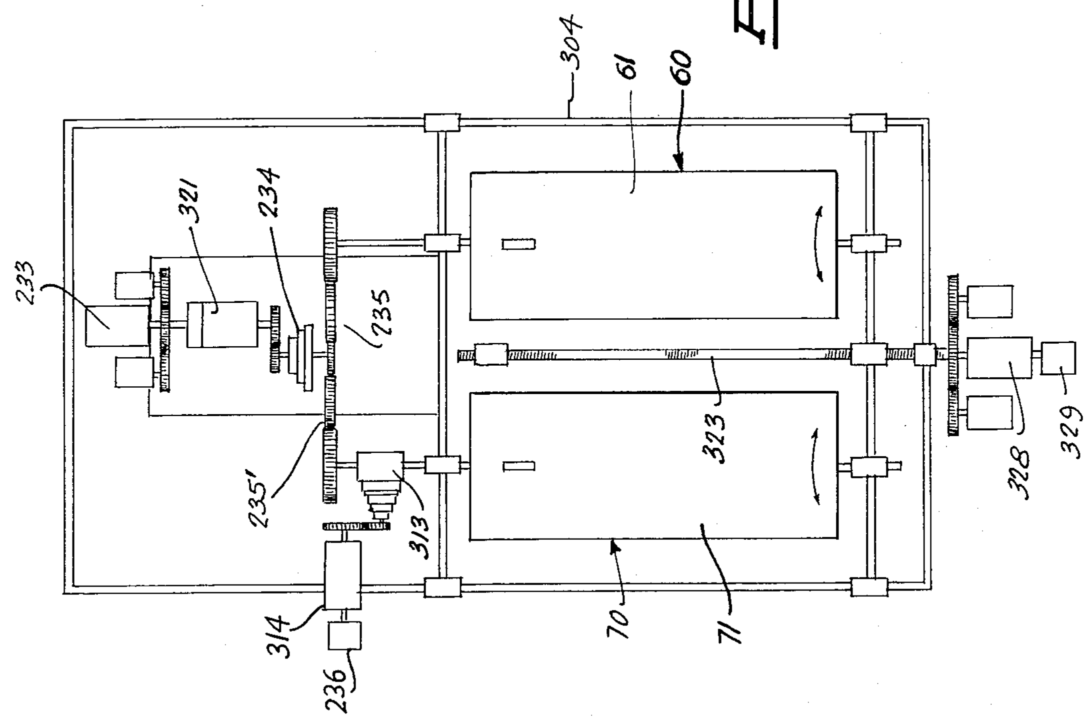

Fig. 5.

ORTHOCARTOGRAPH

This invention relates to a method and apparatus for producing orthophotographs, particularly for map making, and more particularly relates to a means for making orthophotographs directly from stereo-image pairs of a featured surface such as the terrain.

Any map must be prepared so that it contains information about the terrain it represents, and consequently an orthophotograph can seldom be considered as a final cartographic product. Usually at least some of the information contained in the orthophotograph must be correctly recognized and symbolized to eliminate any ambiguity. Additionally, any map based on the orthophoto technique should contain three dimensional information about the terrain and in many cases also about natural or artificial terrain details such as trees, buildings, hillocks, etc.

Thus, from a flat single picture of the terrain surface, such as an orthophoto it may be impossible to recognize and locate many important terrain details or to derive the three-dimensional information necessary. A more complete approach is to produce stereo-orthophoto pairs instead of a single orthophoto and the present invention provides a method and apparatus for deriving such pairs in a single scanning operation from the original stereoscopic terrain photographs.

We have chosen to term the apparatus of the invention an orthocartograph, which in one aspect is a mechanical photogrammetric plotter from which corresponding sections of stereo-photographic images are corrected and transferred simultaneously by an optical train and printed simultaneously on light sensitive films in a printing unit, the relative positions of both films in every point being rigidly controlled so that orthophotos are produced.

The invention provides a method of obtaining orthophotographs from stereo image pairs, which comprises the steps of;

mounting a stereo image pair with each image of the pair adjacent to a respective scanning assembly,

conveying light from at least one scanning assembly to a light sensitive recording medium,

conveying light from the image pair for viewing as an optical model,

driving each assembly from a rod representing the light ray from the respective image to the optical model and carrying out scanning by moving the rods so that their point of supposed intersection traces out the surface of the optical model, and

moving the light sensitive surface with respect to the light conveyed from the said one scanning assembly in synchronism with the movements executed by the rods.

The invention, also provides an apparatus for producing an orthophotograph from a stereo image pair which comprises;

a fixed frame, a pair of second frames received in said fixed frame and pivoted for rotation about an axis, a pair of third frames each respectively received in a respective second frame for pivoting about an axis in the plane of said first axis but at right angles thereto,

means on each said third frame for supporting one image of said stereo pair,

optical means carried on each said third frame for scanning a respective one of said image pairs and movable parallel to the plane of said supporting means,

viewing means coupled to said optical means for viewing said stereo image pair as an optical model,

rod means for moving said optical means, each said rod being pivoted to pass through a respective chosen point whereby said rod represents the light ray from the respective image to the optical model,

means for moving said rods to correspond to intersection on said optical model,

measuring mark means in said viewing means, and

optical train means connected to said optical means for transferring at least one image picked up by said optical means to at least one optical recording medium.

The optical means may be movable in two directions at right angles to one another, or may be pivotally mounted and be movable radially from the pivoted point.

The apparatus of the invention will now be described with reference to the accompanying drawings in which;

FIG. 1 is a three dimensional partly skeleton view of the basic apparatus of the orthocartograph,

FIG. 2 shows diagrammatically the details of the optical train for producing one of the orthophotos from the apparatus,

FIG. 3 shows a detail of part of FIG. 1,

FIG. 4 is a similar view to FIG. 1, but of a different embodiment, and

FIG. 5 is a plan view of two printing drums shown in FIG. 4 and their servo mechanisms.

As shown in FIG. 1, the apparatus for carrying out the invention consists of a pair of photographic image mounting platforms 1 and 2 upon which stereophotographic images 3 and 4 are received. The platforms 1 and 2 form part of frames 5 and 6 respectively, which are mounted in bearings 9 and 10 respectively for pivoting in the ω direction about the X-axis in frames 15 and 16 which are in turn pivoted in bearings 17 and 18 in a fixed frame 19 about the ϕ axes in the Y direction.

Referring now only to the mount for platform 1 (that for platform 2 is identical); mounted in the frame 5 are slide bearing assemblies 25 and 26 movable in the Y direction supporting a slide 27 carrying an optical assembly 28 movable on slide 27 in the X direction. The assembly 28 is connected by a gimbal or a ball and socket 24 (FIG. 3) to a rod 29 mounted in a gimbal 30. The gimbal 30 consists of support bearings 31 in the frame 5 and includes inner bearings 32 supporting an inner ring 33 in which the rod 29 slides in a sleeve 34. The lower end of the rod 29 is received in a sleeve bearing 40 pivoted in a gimbal carried by yoke 41. The yoke 41 is mounted on a rod 42 adjustably carried in a sleeve 43 which is itself oriented so that rod 42 is held aligned in the Y direction. The sleeve 43 is carried on a vertical rod 45 mounted for adjustably sliding vertical movement in a bushing 45 itself mounted on sleeve 46 slidably carried on a transverse slide rod 47 extending in the X direction. The rod 47 is mounted in a box 50 itself mounted on a vertically movable rod 51. The rod 51 is carried in a gear box 52 which can be driven in the X direction along slides 53 suitably by a screw drive 54. Each end of the slides 53 is received in slidably mounted boxes 55 and 56 movable in the direction by suitable drive means such as screw 57.

The optical train from the assembly 28 to the drum 60 carrying film 61 is shown diagrammatically at 62 and focuses an image of the point directly above the objective 63 of assembly 28 on the image 3 (and shown at 64) onto the film 61. A beam splitter 59 (FIG. 3) preceeds the optical train 62 for directing the image of point 64 into one lens of a binocular viewer (not shown) for use by the operator. The optical train 62 also includes a variable magnification and image angle correction for tilt of the original photographs 3 and 4. This will be explained later with reference to FIG. 2.

The structure of the assembly associated with photograph 4 is similar and optical train 72 provides an image of the point on photograph 4 being observed above optical assembly 14 and both for register on film 71 carried by drum 70 and for the second viewing eyepiece of the binocular viewer (not shown).

The drive for the drum 60 is a servo system in synchronism with the scanning in the X direction given to screw 54. Scanning of the film 61 in the Y direction as the screw 57 is rotated, can be achieved by longitudinal movement of the drum 60 in the Y direction. By suitable design of the optics, the lengthening and shortening of the optical train occasioned by the movements of assembly 28 can be accommodated by making the light parallel (focus at infinity) over the section 58 where lengthening and shortening of the optical train is required. Means is also provided for driving drum 60 differentially from drum 70 carrying the second film 71, so that artificial parallaxes are introduced into the film 71 to provide the three dimensional relief information when film 71 is used as a stereo-orthophoto to film 61.

Dealing now with operation of the apparatus in FIG. 1, scanning in the X direction is conducted by the rotation of the screw 54 which drives the rod 47 also in the X direction carrying the gimbal 40, and by pivoting in the gimbal 30, assembly 28 is also driven in the X direction. In synchronism with this movement, the drum 60 is rotated. At the same time, the assembly 148 beneath photograph 4 is driven at the same rate in the X direction. Provided there are no height variations in the points scanned during this movement, the floating mark viewed in the viewing assembly by the operator will appear to remain in contact with the surface of the optical model seen in the viewing assembly, and the images will be conveyed directly onto the films 61 and 71 by the optical systems 62 and 72 respectively. Before the return scan in the −X direction, screw 54 is stopped and screw 57 and the drums 60 and 70 are displaced a chosen small distance Δy in the Y direction with respect to the optical trains 62 and 72, to build up the second scanned strip during the return scan. When, during the scanning there are height differences in the optical model, the operator will observe the necessity to apparently move the floating mark with respect to the optical model and will therefore alter the height of box 50 with respect to box 52. These movements in the Z direction are conveyed to a differential drive 80 for drum 70 such as by a suitable servo motor coupling to introduce a artificial parallax in the film 71 when viewed with respect to orthophoto 61.

Tilt of photographs 3 and 4 is compensated for in the scanning by orienting the frames 5 and 6 by rotation in bearings 9, 17, 10, and 18 respectively, so that photographs 3 and 4 are positioned with respect to the vertical as they were in the original photographing camera.

Variations in magnification required in the optical train when converting from the photographs to the orthophotos to achieve the exact scale in the orthophotos is accommodated in the optical train as will be described later.

The ability of the rod 42 to be slid in bearing 43, rod 45 in support 48, and sleeve 46 on rod 47 allows for compensation in the relative X, Y, and Z shifts between photographs 3 and 4 from the chosen ideal datum.

Reference now to FIG. 2 shows details of the optical train 62 for building up the image on film 61. Light received from the objective assembly 28 is parallel and passes through the dove prism 100. The prism corrects for ω tilt offset of the scanning slit angle, the image being rotated by an amount dependent upon the position of cam 101, which is turned in accordance with the position of an inclined ramp 102 driven by a screw 103 on the shaft of a servo-motor 104, proportionately with the X displacement of the point being scanned. The angle of the ramp is made proportional to ω so that the correction applied is proportional to ω X.

Light which is passed through the dove prism 100 then travels to the basic magnification lens assembly 105 which sets the scale difference between the photograph 3 at the principal point and the image recorded on the film 61. The light then passes through the variable magnification unit 110 which is a zoom lens assembly driven by an arm 111 in turn operated by a cam 112. The cam 112 is received on a shaft output from a differential 113. The two inputs to the differential are from a servo-motor 114 following the Z-coordinate obtained from the height adjustments of box 50 with respect to box 52 (see FIG. 1) and a second input from a second differential 115 having input shafts 116 and 117. Input shaft 116 is coupled to a lever arm 118 which is received on a ramp surface 119 whose inclination is adjustable in accordance with the ϕ tilt of the photograph 3 and which is driven by a screw drive 120 coupled to a servo-motor 121 in accordance with the X-coordinate of the scanning carried out by the apparatus of FIG. 1. The second second shaft 117 is driven from a lever arm 125 whose end rests on the inclined ramp surface 126 and whose angle is adjustable with respect to the longitudinal direction of a screw drive 127 in accordance with the ω tilt of the photograph 3. The screw drive 127 is coupled to a servo-motor 128 driven in accordance with the Y-coordinate of the scanning apparatus of FIG. 1.

Thus, the magnification introduced by the assembly 110 will vary firstly in accordance with the Z-coordinate so that for objects which are closer to the camera, the magnification will be reduced by servo 114 and vice versa. Tilt in ω leads to enlargement to a varying scale of the photograph in the Y direction. The combination ramp 126 and servo 128 corrects for this. Similar compensation for varying scale in the X direction due to ϕ tilt is provided by ramp 119 and servo 121.

Although we have just considered the optical train 62, the train 72 is exactly similar and provides the same compensation for images to be recorded on film 71 from the photograph 4. The differential drive 80 for introducing the desired horizontal parallaxes into the film 71 with respect to the strict orthophotograph 61, modifies the displacement of the drum 70 so that it is proportional to the Z-coordinate obtained from the separation of boxes 52 and 50.

Although we have described one particular type of apparatus for producing the optical compensation in the trains 62 and 72, it will be clear that mechanical differentials and servo driven ramps may be replaced by suitable electronic means which will be apparent to those skilled in the art, which can provide the corrections necessary in the drive to the unit 110 or prism 100 so that the magnification and image tilt follow the desired relationship mentioned above. Pick-up for the X and Y signals can usefully be obtained by driving the screws 54 and 57 from a signal generator whose output is also used for the servo motors 128, 121 and 104. The Z-coordinate pick-up may for instance, be obtained by digital or continuous indexing means between rod 51 and the gear box 52. This may be optical, mechanical, magnetic, electrical or any other type well known to those skilled in the art. The adjustments in rod 42 and bushing 43 to compensate for Y shift between the two photographs, adjustments in rod 45 and bushing 48 for Z displacements, and in rod 47 and sleeve 46 for X compensation, can all be set up before the scanning process, by methods well known to those skilled in the art for aligning photographs from which optical models are to be constructed. Although not detailed, similar corrections for Y, Z, and X are provided by the coupling assembly between rod 47 and 149.

In FIGS. 4 and 5 there is shown an electromechanical apparatus, and parts similar to those shown in FIGS. 1 to 3 are designated by the same reference numerals, and the previous description is relied upon to describe these parts.

In this apparatus a carriage 200 is mounted on guide rails 202 and 203 for movement along the axes X and Y respectively, and which in conjunction with a Z movement of scaffold 199 transmits these motions to the optical assemblies 28 and 148 (not shown) below photographs 3 and 4. The gimbals 30 and 30′ slide mountings 205 and 209, and negator spring balance mounting 210 facilitate set up the movement of the optical assemblies in these directions. The carriage 200 is moved along the guide rails 202 and 203, by ballscrews 206 and 207 respectively. The scaffold 199 is driven in the Z direction by ballscrew 208 along rail 204. The ballscrews 206, 207 and 208 each have the same pitch of 2.5 mm (12.7 mm pitch diameter). The ballscrews 206, 207 and 208 have shaft position encoders 211, 212 and 213 respectively connected to them and electric motor drives 221, 222 and 223 respectively. Each shaft position encoder emits 2,500 pulses per revolution of the respective ballscrew 206 to 208, which gives a 1-micron resolution in combination with the 2.5 mm ballscrew pitch. The encoders 211 and 213 provide signals for position coordinate display counters 224 and 225 respectively. Encoder 213 is connected to a position control 226 which operates electric motor 223. A tachometer 227 is connected to electric motor 221, and to a speed control 228 which controls electric motor 221. The encoder 212 is connected to a preset indexer 230, which controls electric motor 222. Three precision potentiometers, one of which is shown and designated 232, are respectively connected to the ballscrews 206 to 208 for magnification corrections in the printing optical system, as will be described later.

The orthophotographs are made, as in the previous embodiment on films 61 and 71 by scanning photographic images strip after strip along the X-axis on the platform 1 and 2 by similar optical means (not shown) to that used in the embodiment described with reference to FIGS. 1 to 3. The scanning speed of the carriage 200 along the X-axis is 5 mm per second maximum (120 r.p.m. of pitch). The electrical motor 221 is controlled by the speed control 228. The width of the scanning strip is obtained, by incremental movements of the carriage 200 along the Y-axis by ballscrew 207, by electrical motor 222 which has a known type of preset indexing means 230. The preset indexing means 230 emits the number of electrical pulses required for a predetermined small Y movement, Δy, and these electrical pulses to the motor 222 are emitted by the carriage 200 actuating a switch (not shown) at the end of the X-travel. After the carriage 200 is moved Δy the indexing means 230 resets itself to the number of pulses required for the predetermined Δy, and is then ready to be actuated by the switch once more.

The ballscrew 208 can either be driven by a hand crank (not shown) or by a foot actuated position control 226, and provision is made for an electrical motor drive 223.

The simultaneous printing of the stereopair of orthophotographs 61 and 71 is performed by a stationary optical system with the orthophotographs 61 and 71 mounted upon revolving drums 60 and 70 respectively. To the drum 70 an artificial parallax, as a function of Z, is introduced by electric motor 314 differential 313, and cam 312, through encoder 236.

As in the previous embodiment speeds of the orthophotographs 61 and 71 must precisely correspond to the scanning speed at the optical model increased by magnification.

The drums 60 and 70 are mounted respectively in bearings 300 and 301 in a frame 302 slidable longitudinally of the axis of the drums on a frame 304.

Both of the drums 60 and 70 must revolve at precisely the same speed and so are arranged to be driven by a single printed circuit motor 321 mounted on frame 302 controlled by an encoder 233, through a gear box 234 provided to select the desired magnification of up to five times, depending upon the scale of the orthophotograph.

The required number of revolutions per minute of the drums 60 and 70 is very small. Idler gears 235 and 235′ are incorporated into the drives for the drums 60 and 70. The corresponding shift is combined with the X scanning speed by the differential 313.

The scanning strip with increment Δy of the drums 60 and 70 is achieved in the same way and in the same time as the shift of the carriage 200 relative to an apparent position of an optical model. The scanning movement Δy on the drums 60 and 70 which is effected by a ballscrew 323 driven by a motor 328 mounted on frame 304 (the screw 323 carries encoder 329) must be magnified by the same factor as the scanning speed of an optical model; therefore the number of pulses required from encoder 329 for Δy at the optical model must be amplified by it and the indexers 230 and 237 preset accordingly. The indexers 230 and 237 are actuated by the same switches (not shown) at the end of each scanning strip.

As in the previous embodiment the mechanical magnification of the X and Y movements of printed orthophotographs must be accompanied by the correct optical magnification of the projected image from each photographic image on platforms 1 and 2, The required magnification factor must be established at the time of relative orientation. The basic magnification of the image must be corrected continuously to compensate for the errors in magnification due to ω tilt, ϕ tilt and elevation variation Z.

It is assumed that the errors are linear and proportional to ω, ϕ and the distance from an apparent principal point on the optical model, with corresponding positive or negative signs depending upon the tilt direction. In Z error signs the positive and negative correspond to "above" and "below" an apparent reference plane on the optical model.

The magnification correction and tilt from all of the three sources of errors ϕ, ω and Z are introduced by means of precision potentiometers 239 and 240 coupled by gears and screws to zoom lens assembly 110 and dove prism assembly 100. The "zero" potential is in the middle of the travel of the potentiometers 239 and 240, and corresponds to the apparent principal point on the optical model. The electrical potentials (+V) and (−V), proportional to the magnitude and direction of errors, that is functions of ϕ, ω, and Z are applied to the potentiometers 239 and 240 and from there to the electrical motors 242 and 244 respectively, and are used to drive a servo-control, which adjust the zoom lens assembly 110 and dove prism assembly 100 (for ω tilt) respectively. In this way the same corrections are applied to the image for recording as was done mechanically in the embodiment of FIG. 2.

Although the film carriers 60 and 61 have been shown as drums, it is clear that they may be flat and mounted and relative movement in any suitable way provided to give the scanning required. The relative movement may be achieved by movement of the film carriers and/or the printing head.

It will be understood too, that this apparatus can be used for producing stereo-orthophotos, pseudo-stereo ortho-photos, or single orthophotos as desired. Stereo-orthophotos are defined as stereo pairs of orthophotographs in any form in which one picture has geometric characteristics of an ortho-photograph (that is uniform scale throughout the image) and the second picture has built-in horizontal parallaxes with specific characteristics for giving terrain height information. Pseudo-stereo orthophotos are defined as stereo pairs in which both pictures have the geometric characteristics of an orthophoto-graph. In the latter case only height information on local details can be obtained.

In addition, the apparatus may introduce marking or numerical recording of contour positions by providing scribing means which can be made coincident with the projected image onto the film 61 or 71. Shading plates or patterns may be introduced to depict terrain relief by modifying the intensity, for instance, of the image focused onto film 61 or 71 and the data of X, Y, and Z coordinates may be recorded for future numerical processing.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of obtaining orthophotographs from a stereoscopic pair of images of a featured surface, comprising the steps of,
 mounting each image of the pair adjacent to a respective optical scanning assembly,
 conveying light from each image as scanned by the respective scanning assembly for viewing as an optical model of the featured surface in conjunction with a stereoscopic measuring mark,
 driving each assembly from a respective rod representing the light ray from each respective point of features on said images to the corresponding point on the optical model brought into conjunction with the measuring mark,
 moving the rods for scanning the optical model past the measuring mark by a movement which consists of,
 a first translating motion across the optical model,
 a second translating motion transverse to the first translating motion,
 and a third vertical motion at right angles to the translating motions,
 directing light from each said point on one of said images to a light sensitive recording medium surface for producing a projected image of said point;
 and moving said light sensitive recording medium surface with respect to said projected image of said point in translating motions respectively at right angles and proportional to said first and second translating motions,
 said third motion being conducted for positioning said rods so that the said corresponding points on the optical model are moved vertically into conjunction with said measuring mark, the total record of said projected image on said recording medium surface thereby constituting an orthophotograph of the featured surface.

2. A method as defined in claim 1 including the further step of;
 directing light from each said point on the second of said images of the image pair to a second light sensitive recording medium surface for producing a second projected image of said point,
 moving the second light sensitive recording medium surface with respect to the second projected image of said point in translating motions respectively at right angles and proportional to the first and second translating motions, and adding to the translating motions proportional to the first translating motion a movement proportional to the third motion, the second light sensitive medium when viewed subsequently in stereoscopic conjunction with the first light sensitive recording medium showing stereoscopic height information and the first recording medium presenting an orthophotograph of the featured surface.

3. An apparatus for producing an orthophotograph from a stereo image pair which comprises;
 a fixed frame, a pair of second frames each received in said fixed frame and pivoted for rotation about a first axis,
 a pair of third frames each respectively received in a respective second frame for pivoting about a second axis in the plane of said first axis but at right angles thereto;

planar means on each said third frame supporting one respective image of said stereo pair,

optical means carried on each said third frame for scanning the respective one of said image pair and movable parallel to the plane of said supporting means,

viewing means coupled to said optical means for viewing said stereo image pair as an optical model,

stereoscopic measuring mark means in said viewing means,

respective rod means for moving each said optical means, each said rod means being pivoted to pass through a respective chosen point with respect to its associated third frame whereby said rod represents the light ray from a chosen viewed point on the respective image to the corresponding point on the optical model,

means for moving said rods to deflect viewed points on said optical model into conjunction with said measuring mark means,

an optical train means connected to said optical means for projecting from said one image, a projected image of chosen points viewed on said optical model in conjunction with the measuring mark means,

a light sensitive recording medium surface receiving thereon the projected image,

said rod moving means comprising;

first means for deflecting said optical model with respect to said measuring mark in a first direction across said model,

second means for deflecting said optical model with respect to said measuring mark means in a second direction across said model at right angles to said first direction,

third means for deflecting said optical model vertically with respect to said measuring mark means and

means for moving said light sensitive recording medium surface with respect to said projected image in a first motion proportional to movement of first means for deflecting and in a second motion at right angles to the first motion proportional to movement of said second means for deflecting.

4. Apparatus as defined in claim 3 including,

second optical train means connected to said optical means for projecting from the other of said images a second projected image of said chosen points viewed on said optical model in conjunction with the measuring mark means,

a second light sensitive recording medium surface receiving thereon the second projected image,

means for moving said second light sensitive recording medium surface with respect to said second projected image in a fourth motion proportional to movement of the first means for deflecting and proportional to movement of the third means for deflecting, and means for moving said second light sensitive recording medium surface in a fifth motion proportional to movement of the second means for deflecting.

5. Apparatus as defined in claim 4,

said first and second light sensitive recording medium surfaces being mounted on the surface of a respective cylinder, the first and fourth motions being effected by rotation of said cylinders about their respective axis and the second and fifth motions by movement of the cylinders in the direction of their respective axis.

6. Apparatus as defined in claim 5, including differential means for driving the cylinder supporting said second recording surface from the cylinder supporting said first recording surface, in accordance with movement of said third means for deflecting.

7. Apparatus as defined in claim 3 in which the chosen point of each said rod lies at the intersection of the first and second axis for the respective frames.

8. Apparatus as defined in claim 5 comprising projected image magnification compensating means in each optical train means responsive to said first and said second and said third means for deflecting.

9. Apparatus as defined in claim 8 each said optical train means including projected image tilt correction means responsive to said first means for deflecting.

10. Apparatus as defined in claim 8 each said projected image mangification compensating means including means responsive to tilt of the images of said stereo image pair.

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